# SYNOPSIS OF THE THESIS

## ASSESSMENT OF PHYSICAL PROPERTIES AND SEW ABILITY PARAMETERS OF AHIMSA SILK AND NON AHIMSA SILK FABRIC AND PRODUCT DEVELOPMENT

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Doctor of Philosophy

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## Introduction

## The conventional silk

Silk is the natural protein filament fiber known as the "Queen of Textiles", a title well deserved by virtue of its association with royalty, the care required in its culture and the properties and characteristics with which it has been endowed.
The silk is obtained after the silk worm has undergone a complete metamorphosis and escapes out of the cocoon. Silk worms are the larval forms of Bombyx mori which is the species used for commercial cultivation.

The larvae are placed in bamboo baskets or bamboo shelves in a temperature controlled room with good air circulation.

They are fed mulberry leaves during this stage. As they go into the pupal stage, they secrete substances called fibroin and sericin around them. These substances harden when they come in contact with the air, thereby producing a cocoon.

The cocoons are immersed in boiling water to kill the worms and collect the silk threads.

## Ahimsa Silk

The Hindi word "Ahimsa" means “non-violence”. This new way of the production of silk yarn is also known as “peace silk”. Both names are very fitting as they help sum up the movement behind the product. World Ahimsa Day is celebrated on Gandhi Jayanti - 2nd October to glorify the “Peace of Silk”.
Ahimsa Peace Silk is made in a non-violent, eco-friendly and sustainable process of the production was developed in Andhra Pradesh. Ahimsa Peace Silk does away with brutal practices in the silk production without compromising on the quality of the silk and the productivity of operations. Unlike the conventional method where the pupae are killed before reeling yarn from the cocoons, in the process of Ahimsa Peace Silk production the adult moths are allowed to emerge alive from the cocoons and then the silk yarn is spun from the open ended or pierced cocoons found in the wild or from those used in breeding cycles.

The silk moths best suited for the production of ahimsa silk are the Eri Silk Moth (Philosamiaricini). These feed on the castor plant in contrast to the conventional mulberry feeding silk moth. Other species that are being used for Ahimsa Peace Silk are the Tassar moths (both tropical and temperate-Antheraea mylitta and Antiheraea proylei) and the Muga Silk Moth (Antheraea assamensis). These are wild and semi wild silks. Therefore, after this process a silk is produced without killing of silk worms so all consumers who care for the environment and respect the right of life for all the living beings can wear this product with a clear conscience and enjoy the soft and luxurious feel of spun silk. While ahimsa silk may lack the shine of regular silk, it is comfortable to wear. It’s also wrinkle free and has a better fall. Now days it is very much in demand and requires availability of a large range of products in the market.

Ahimsa Peace Silk creates unique products that appeal to the demand of environmentally conscious and non-violent clientele all over the world. It provides an alternative for discerning and aware consumers to make their choices in such a way that even as they buy silk they are able to accord the respect that our fellow living beings on the earth deserve from us.

The silk from broken and damaged cocoons or torn filaments is transferred into spun yarns. Spun silk is relatively less elastic, duller and stiffer than thrown silk and also less expensive. Further, the spun silk is mostly used for low grade silk cloth for apparel, upholstery and draperies. The wooly white Eri silk is often referred to as the Ahimsa silk or the fabric of peace as the process does not involve the killing of the silk worm. Eri silk fabric is a boon for those who practice absolute non-violence and do not use any product obtained by killing any living creature. Hence, Vegans and other monks in India prefer this silk.

In ahimsa silk production, the cocoons are allowed for another week to 10 days for the worms to complete their metamorphosis. After the moths have emerged and free them from the cocoon the extraction of peace silk begins. Ahimsa silk may have fewer lusters, but it is very soft to touch and gives a message of peace to the world.

**Properties of Ahimsa Silk**

Every fabric produced on hand loom, power loom or in mill sector need to perform the intended functions satisfactorily. In other words, money spent on clothes is worth serves the purpose of maximum utility of the consumer. Of the several properties, durability or service-ability is prime feature that depends on the constructional details of the cloth. The properties of silk, breaking strength and extension at break are considered to be important ones.

The functional properties viz., tensile strength, elongation, resistance to abrasion and pilling significantly influence the fabric serviceability. However, these properties are derived from fiber and yarn quality that ultimately constitute the fabric structure. Furthermore, the functional properties along with the inherent fiber characteristics contribute greatly to the fabric behavior under deformation and comfort. The spun silk from pierced cocoons without killing pupae considered as "Ahimsa silk" is widely accepted by Hindus and Jain royal families in India. Thus the silk spun from mulberry pierced cocoons is referred as "Ahimsa silk". The coarser uneven Ahimsa silk yarn is most suitable for handloom sector and appropriately used as shot weft.

## Sewability parameters:

Stitches and seams are two important elements of apparel construction. Stitches are used to join the materials and hold the apparel together, and seams give the shape/contour and detail of the apparel. These two elements together with the material properties contribute to the quality of the apparel.
In cut and sewn apparel products, seams are formed when two or more pieces of fabrics are held together by stitch. As the seam is one of the basic requirements in the construction of apparel, seam quality has great significance in apparel products, consumers evaluate seam quality mainly based on the seam appearance and its durability after wear and care procedures. The quality of seam has to be evaluated by the manufactures during product development and production. Seams should be of the appropriate quality that could provide adequate performance to ensure serviceability in use and to provide saleable appearance.

In general, the seam quality mainly depends on the strength and the appearance of the seam itself. A good quality seam must have flexibility and strength with no seaming defects such as puckering or skipped stitches and the overall appearance of the seam must meet the design requirement of the apparel products.

There are several functional and aesthetic requirements for good quality seam. Seam quality is evaluated based on various dimensions: seam efficiency, seam elongation, seam bending, seam stiffness, seam abrasion resistance, seam density, seam slippage, seam puckering, seam tightness, seam boldness and seam damage. Seam efficiency, seam elongation, seam density, seam slippage, seam bending stiffness and seam abrasion resistance are the dimensions for functional performance of the seam. In contrast, seam puckering, seam tightness; seam boldness and seam damage are mainly evaluated for better aesthetic performance of the seam.

Different stitch densities are selected based on fabric weight category. Fabrics are sewn with different types of sewing thread in terms of thread size, structure and fiber content. Needle size is selected according to the size of the sewing thread. After sewing, sewn fabrics are evaluated for appearance and strength in order to investigate the changes in terms of overall quality after alterations in the sewing parameters. By changing the parameters, the fundamental rules of sewing can be understood and the selection of parameters can be optimized in order to achieve good sewing quality (Gribaa, Amar et al. 2006).

Seam pucker: Pucker - as the contracting or gathering (of brow, seam, and material) into wrinkles, folds, or bulges, intentionally or as a fault e.g. in sewing. Galuszynski (1986) in his wide survey on seam pucker used the following definition: -a distortion of the fabric along the seam line, causing a wrinkled appearance.

Seam pucker is defined in the Oxford English Dictionary as “a ridge, wrinkle or corrugation of the material or a number of small wrinkles running across and into one another, which appear in sewing together two pieces of cloth”.

Seam quality: A seam is a joint between two pieces of fabric and is defined as ‘the application of a series of stitches or stitch types to one or several thicknesses of material’.

Seam strength: Meanwhile, longitudinal loading refers to a load that is applied parallel to the direction of the sewing where it is closely related to the extensibility of the seam (Friend 1989; Laing and Webster 1998).

The seam strength can be affected by the changes of seam and stitch type because it affects the interlacing of sewing thread with yarns in the fabric (Gribaa, Amar et al. 2006).

Elongation in the seam can be defined as the amount that a seam can be stretched without breaking and a suitable stitch type, seam type, thread tension, stitch density, sewing thread and fabric properties are needed so that the seam can elongate the same amount as the fabric (Glock and Kunz 1995).

Needle: The sewing needle is one of the basic elements that directly contribute to seam formation. The way the needle penetrates the fabric during sewing will give different effects in respect of seam strength and garment appearance (Stjepanovic and Strah 1998).

The pressure from industry for higher productivity has been matched in recent years by considerable increases in sewing speeds. Apart from increases in speed, new types of textile materials and new finer sewing threads have also been developed, which have required finer sewing needles and improved control of the sewing process. These developments have not been without their associated problems during the course of clothing manufacturing, e.g. achieving pucker less seams at higher sewing speeds required finding the appropriate combination of needle, thread and sewing parameters.

## Objectives of the study

The study is conceptualized with the following objectives:

- To assess and compare the physical and comfort properties of Ahimsa silk and non Ahimsa silk fabrics.
- To assess the sew ability parameters of Ahimsa silk and non Ahimsa silk fabric.
- To develop product according to the fabric sew ability performance.
- To assess the acceptability of the developed products.

## Review of Literature

A review of literature is a systematic search for pertinent information on a specific and a systematic method for identifying and interpreting the existing body of record work produced by the researcher and practitioners. A literature is reviewed by the researcher, which gives an idea of the work done in the field of the study and help in keeping in touch with the recent developments. A few studies that have been conducted on properties of Ahimsa silk and non Ahimsa silk, testing the sew ability parameters and assess the acceptability of product over the year are quoted as below:

- Physical properties of silk fabric
- sew ability parameters
- Development of apparel products

## Physical properties of silk fabric

Gamal (2014) correlated garment appearance and fabric drape from FAST mechanical properties. The garment appearance value was visually assessed. Twenty four fabrics were used in this study. Groups of fabrics according to their weight (light, medium, and heavy weight fabrics). Eight designs were created for each group. A three level questionnaire was used for selecting the optimum design. FAST System was used to measure fabric low stress mechanical properties. Results found that the garment appearance is affected by combinations of fabric properties. There is no single fabric property that can describe the garment appearance. Fabric drape is important in garment appearance. It could not by itself describe the garment appearance. The more draped fabrics give higher garment appearance. The relationship between garment appearance, fabric mechanical properties, and fabric drape is not Linear.

Comment [G1]:

The static and dynamic drape of fabric is an emerging arena of fabric evaluation. Conventional static and new dynamic drape coefficients of silk woven fabrics were examined precisely Pratihar (2013). Result showed that drape is one of the most important fabric properties particularly from designer's point of view. Earlier researches in textile mechanics mainly focused on the understanding of relationship between the mechanical properties of fabric and those of the yarns as well as fabric structures. Therefore, dynamic drape behavior and dynamic drape coefficient are gaining more and more popularity day by day. It is so, because it gives to some extent close to real life situation. Partial simulate drape behavior test data one can predict the further application behavior of the fabric. It will also be helpful for categorizing the fabric in terms of its fabric fall behavior.

The effect of organic solvents on tensile strength of Muga silk produced by Antheraea Assamensis was studied by Talukdar, 2011). Study was conducted on physical properties like tensile strength, etc. on Muga, Eri and mulberry silk fibers. Fresh cocoons of Antheraea

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Comment [G4R3]:

assamensis were used for the study. A sample without chemical treatment has been tested as control sample. Result showed that organic solvent methanol and phenol treatments increased the tenacity of Muga silk although tenacity after phenol treatment was not higher than the untreated silk. Fine silk fibers had higher tensile strength. The silks with highest tensile strength could be used in textile and other related application.

Prakash and Koushik (2010) found out the effect of loop length on the dimensional properties of silk and model union knitted fabric. In this study, single jersey plain knitted fabric samples with three different loop lengths were produced. Result showed the increase in courses per inch with an increase in loop length. Courses per inch increased after wet- relaxation. Wales per inch decreased with an increase in loop length. Wales per inch decreased after wet- relaxation. Loop length increased after wet relaxation process. Increase the thickness of fabric with an increase in loop length. The dimension of fabric shows considerable change during wet relaxation.

Kariyappa (2007) found the effect of mechanical rising on properties of Eri spun silk fabric. The unfinished fabric and raised fabric were tested for mechanical properties and results were compared. Result showed that after raising (Fuzzy finish) of the fabric, properties like fabric thickness, abrasion resistance, linear density of the yarn, breaking strength and thermal insulation values were increased, water repellency remained the same and elongation percentage: fabric weight, air permeability, cover factor, bursting strength, drape coefficient, stiffness and fabric shrinkage decreased. After rising of fabric, the fabric become thicker, lighter in weight, warmth and softer and raised fabric are more durable. Abrasion resistance has increased of fabric.

Ahimsa silk shirting materials were evaluated to know the influence of mechanical properties on it serviceability of the shirting material. Objective of the study assessed for functional properties to evaluate the influence of mechanical properties on the durability of the Ahimsa silk fabric (Sanapapamma and Shailaja, 2007). The union shirting materials were tested for mechanical and functional properties as per the standard method in Karnataka. Result showed that cotton x Ahimsa silk (Sc) was relatively thicker fabric, which might be due to coarser yarn count and presence of sizing materials on the surface than the tricot and filature silk content shirting material. Ahimsa silk was considered to be stronger than cotton, tricot and filature silk. Filature silk x Ahimsa silk shirting higher the treads per unit area better the stretch ability. Yarn count significantly influenced the cloth tensile strength but the relation was negative, i.e. increase in yarn count turned into decrease in tensile strength. Cloth count positively influenced the warp way elongation of newly designed shirting, but the relationship was negative in weft way. Newly woven shirting materials exhibited low resistance to abrasion attributed to its yarn count, low thickness value and pliable texture.

## Sew ability parameters:

In a study, three different types of fabrics (satin, chiffon and tulle) were sewn together for wedding and soiree dresses, different counts were selected to study seam strength, slippage, and bending length and other properties. Result showed that the seam strength, the breaking occurred always at the seam area of joint the two pieces of satin and chiffon fabrics. Material plays an important role for the elongation. The maximum elongation was found with sewing chiffon and tulle together. With the increasing in stitch density, the seam pucker also increased. The significant level between seam pucker and stitch density was 99%. The types of fabrics play an important role on seam pucker. The seam pucker is increasing at satin + chiffon and satin + tulle of fabric type. Avoid seam puckering; it must be used suitable fabric density to get good appearance drape with seam pucker (Shehata, 2015).

Parthasarathi (2014) found that fabric sew ability problems and solutions. Sew ability problems are displayed in finished garments in the form of effects such as damage by the needle, thread breakage, seam slippage and seam pucker. Result show The number of problems related to sew ability, and their economic severity has increased with modern trends towards higher speeds, partial/ or full auto- motion and change in textile material input such as fabric and sewing threads and new dyes in both fabric material and sewing threads. These have created many new problems during sewing operations. Increase speed of sewing machine had been on of the contributing factors towards the increased difficulties in achieving satisfactory seam performance e. g. pucker less and strong seam.

The study investigated, the effect of seam slippage in satin fabrics and factors causing minimizing of this problem. Tests were performed with three types of satin fabrics varying in their fabric contents, weight per unit area, thickness and fabric density Seif (2014). In the method, three types of stitches were chosen for the experimental work. Result show stitch type for minimizing the seam slippage. The increasing and decreasing stitch length could solve the problem of seam slippage. Sewing with needle size 14 was found better than sewing with needle size 16. Seam slippage occurred by warp's direction rather than the other direction. Sewing in bias direction ($45^0$) avoided the failure of the seam slippage generally.

The study conducted the influence of sewing machine parameters on seam pucker. Objective of the study was to evaluate seam pucker by two different parameters. The effect of sewing machine parameters such as, needle count, stitch density, sewing thread tension, and sewing density were explored. Sewing thread tension and sewing direction on seam puckers were studied Nassif (2013). 100% cotton fabric samples were used in the study. The studied samples were sewn with super imposed seam type, on high speed sewing machine with different sewing parameters. Seam pucker of sewn woven fabrics was assessed subjectively and objectively by two different techniques. Result found that most of sewing machine parameters have a significant influence of woven fabric in relation to seam pucker. In this study, good relation

between the subjective and objective measuring method of seam pucker, especially in the case of the effects of needle size and sewing thread tension.

Bharani, Shiyamaladevi and Gowda (2012) investigated the characterization of seam strength and seam slippage on cotton fabric with woven structures and finish. Method used 100% fabrics of different weaves of plain, twill and satin. The sample were tested on an Instron for tensile characteristics, like seam strength and seam slippage. Result shows that breaking load of unfinished samples were depicting higher strength than the finished without seam opening. Plain weave was found to have greater seam performance than the twill and satin.

The study found the influence of mechanical properties of cotton fabrics on seam quality (Ebrahim, 2012). Method and metrial used in study, 20 cotton fabrics are used for experimental. Seam efficiency, seam puckering and seam boldness were tested to evaluate seam quality. The result shows that different factors affecting the seam quality. The shear rigidity and extensibility were closely correlated with the seam efficiency and seam puckering to the seam boldness of the fabric affected to the thickness, weight and shear rigidity.

Itagi (2012) investigated the effect of circular (real) seam on drape of silk apparel fabrics, using Cusick's drapemeter. In this study, investigations of fabric geometric parameters of experimental specimens were done, pure plain woven silk fabrics available commercially and few experimental fabrics with varying GSM values were collected. The sewing method for each seam was to cut up the fabric and then sew the pieces together. Result showed the varying position of a circular seam show varying effects on drape coefficient % (DC %) light and heavy weight fabrics but medium weight fabrics show gradual increase in DC%. The fabric drape for silk apparel fabrics with seams have a significant value for both textile and garment industries because it provides a realistic drape study with respect to garment appearance.

Ghani (2011) studied the performance of seam quality in term of seam appearance and strength constructed with different sewing parameters. In this study, method included five different fabric categories, namely light, light to medium, medium, medium to heavy and heavy weight. A total of 45 fabrics with different weave densities, fiber types and structures were used. Result indicated that usage of thicker threads did not always give better strength and the seam appearance was also poor. A combination of finer thread with moderate strength and a medium level of stitch density according to fabric weight category provided good result for both seam appearance and strength.

The overview on the impact of sewing thread on seam quality and its significance on seam serviceability and seam appearance (Mandal and Abraham, 2010). Result shows that sewing thread properties impart significant influence on the area of seam quality for high consumer's satisfaction. Consumer satisfaction of sewing thread for seam quality is an important for quality control required by the apparel manufactures and their customers. This research was provides information on proper sewing thread selection in the manufacturing of apparel.

The mechanical behavior of seams on treated fabrics was studied by Kordoghl (2009). In the study, woven fabric was chosen to investigate the effect of chemical and mechanical finishing process the behaviour of the seams. Three factors selected the treatment; seam direction and density have been studied. Results show the initial fabrics properties before stitching have an important impact on the behaviour of the seams. The seams explain better the reality limit of use of stitch fabrics. The increasing number of stitch per centimeter doesn't affect the elongation at break. The breaking forces which increase as the density increased.

The study found the effects of different fabric types and seam designs on the seams efficiency. The investigation was focused on joining parameters of fabric using a standard sewing machine (Lapere, 2006). Two different seam designs were investigated on three woven fabrics made from cotton, wool and silk. The wool fabric having the highest weight exhibited the greatest strength compare to cotton fabric and silk fabric. The highest seam efficiency was found in the cotton fabric for both seam types, which was followed by the silk and wool fabric. This may be attributed to the higher friction between the cotton yarn or fabric and the sewing thread than that of the other two fabrics.

A study on seam quality with sewing thread size, stitch density and fabric properties was conducted to analyze the seam quality with commercial sewing thread in woven fabric (Mandal, 2008). In this study, seven different sizes of spun polyester sewing threads were sewn on cotton, woven fabrics respectively. The effect of sewing thread size, stitch density and fabric properties on seam quality, the multiple regression models were selected in this study. Result found the depth analysis of seam quality through different multiple regression modeling technique. The model was help apparel manufactures to evaluate seam quality more effectively when a particular sewing thread size and stitch density are applied on a particular type of fabric.

The study by Gribaa, Amar and Dogui (2006) found that influence of sewing parameters upon the tensile behavior of textile assembly. The study was carried out according to the approach experimental design. The study parameters are the sewing thread, the stitch type. Result shows that highlight the behavior of the seam, a load- extension curve for the stitch line is established. It represents, for a value of a give tensile effort, the difference between the displacement of the assembly and that of the fabric.

Fan (1997) examined the effect of throat plate design on sewing damage on an over lock sewing machine. Method of the study, compare the three throat plates in terms their effect on sewing damage. A sewing trial was conducted on a Juki over lock sewing machine. Result show the sewing damage in light weight knitted fabrics can be minimized by the modification of throat plate design with a view of enlarging the needle gap. Over lock sewing machine may be provided with a series of throat plates of different needle gap sizes for selection for different fabrics. The needle plate having optimum needle gap size can minimize sewing problems.

The study conducted the fundamental factors that affect seam strength (Kornfeld 1952). Method used in the study, the fabric was tested for thread count, thickness, and tensile strength by the

standard method. The speed of the sewing machine, the sewing thread size, needle size, stitch per inch, tension were all the sample of fabric sewed. Each sample was tested for seam strength and seam slippage. Result found the stiffness, seam resistance to slippage, and sewing machine damage should be considered in producing a fabric with a high degree of seam efficiency. The correlation shows definitely that the stiffness affects the seam strength of the fabric. Seam strength of the fabric is directly related to the seam resistance to slippage. The correlation between the fabric stiffness seam resistance to slippage, and sewing machine damage.

Hassan found that setting criteria of the sew ability of organza fabric. Organza silk is a sheer, transparent fabric that has a variety of uses and application. Material was used three types of organza fabric. Organza fabric was sewed using two types of presser foot (plastic and metal) at three pressing levels. Result show that metal presser gives higher seam stiffness than plastic presser. Metal presser gives lower seam pucker than plastic presser. This can be attributed to high press by using metal presser regulates the speed of fabric withdrawal and decreases seam pucker. Metal presser gives higher seam appearance than plastic presser. Metal presser gives better seam properties.

The study conducted by Tester Yildiz (2010) indicates the effects of interlinings to sewability properties of the woven fabrics. In this study, the woven interlinings and the woven fabrics which are usually used for shirts manufacturing were examined. These samples were analyzed for the basic structural parameters: weave type, fabric unit weight, fabric thickness and density. Sewability properties of fabrics had been tested by using L&M Sewability. Results were found regarding the experimental study of the sewability of woven fabrics fused with different interlinings. Fabric weight, thickness and needle penetration force were determined for identifying sewability. The high penetration force showed that the fabric had a high resistance. Because of the high resistance, during the sewing process, the fabric will be damaged. As the same, the fabric with minimum weight and thickness had the minimum needle penetration force. So, the effect of fabric weight and thickness in the needle penetration force was significant.

## Concluding remarks:

Clothing is our basic need and clothes should be durable, comfortable and long lasting. At the same time, they should be moderately priced so that all the sections of society are able to satisfy their requirements. With these objectives, a comparative study of properties of cotton – synthetic blends had been conducted earlier. The previous studies were carried out to analyze the properties, like crease recovery, abrasive resistance and tensile strength of contemporary cotton synthetic blend fabric available in the market. After review of available literature, it has becomes clear that only few studies have conducted on the assessment of physical properties of different types such as pure silk, cotton and synthesis fabric but none of the studies were found on physical and comfort properties of Ahimsa silk fabrics and non Ahimsa silk fabric as compared.

In previous researches, the efforts have been put to evaluate the seam quality. The studies were restricted only to the use of seam quality as an individual dimension. They were either based on functional or aesthetics performance. Moreover, the previous researches were not carried out on seam evaluation. Thus, the studies on seam quality were limited and fragmented. Till date, very limited research work has been undertaken on seam qualities which focus on seam performance and aesthetics together. After reviewing the literature, it was also found that very few studies have been focused on the assessment of fabric properties and seam quality of different types of pure and blended silk fabrics and sewability parameters have not been compared with Ahimsa silk fabric and non Ahimsa silk fabric. Therefore, the present research has been planned with the objective to get a comparative analysis of the foresaid properties of the Ahimsa silk fabric and non Ahimsa silk fabric. Consequently, this study will also incorporate the development of apparel products based on physical and comfort properties.

## Significance of the study

Testing is the most important aspect of textiles quality monitoring and evaluation. There is large variety of testing Instruments available to cover various aspects of textile testing. The study will provide a deep insight into various comfort and performance properties of Ahimsa silk fabric itself and its compatibility with regular silk fabric.

The Study will be emphasis on sewing parameters of fabric for analysis of fabric performance. Every apparel engineer must have clear knowledge about the effect of sewing parameters and stitch density on seam to solve the seam quality problem in the apparel industry. Seam size is also important to the apparel designers and or merchandisers from seam quality point of view.

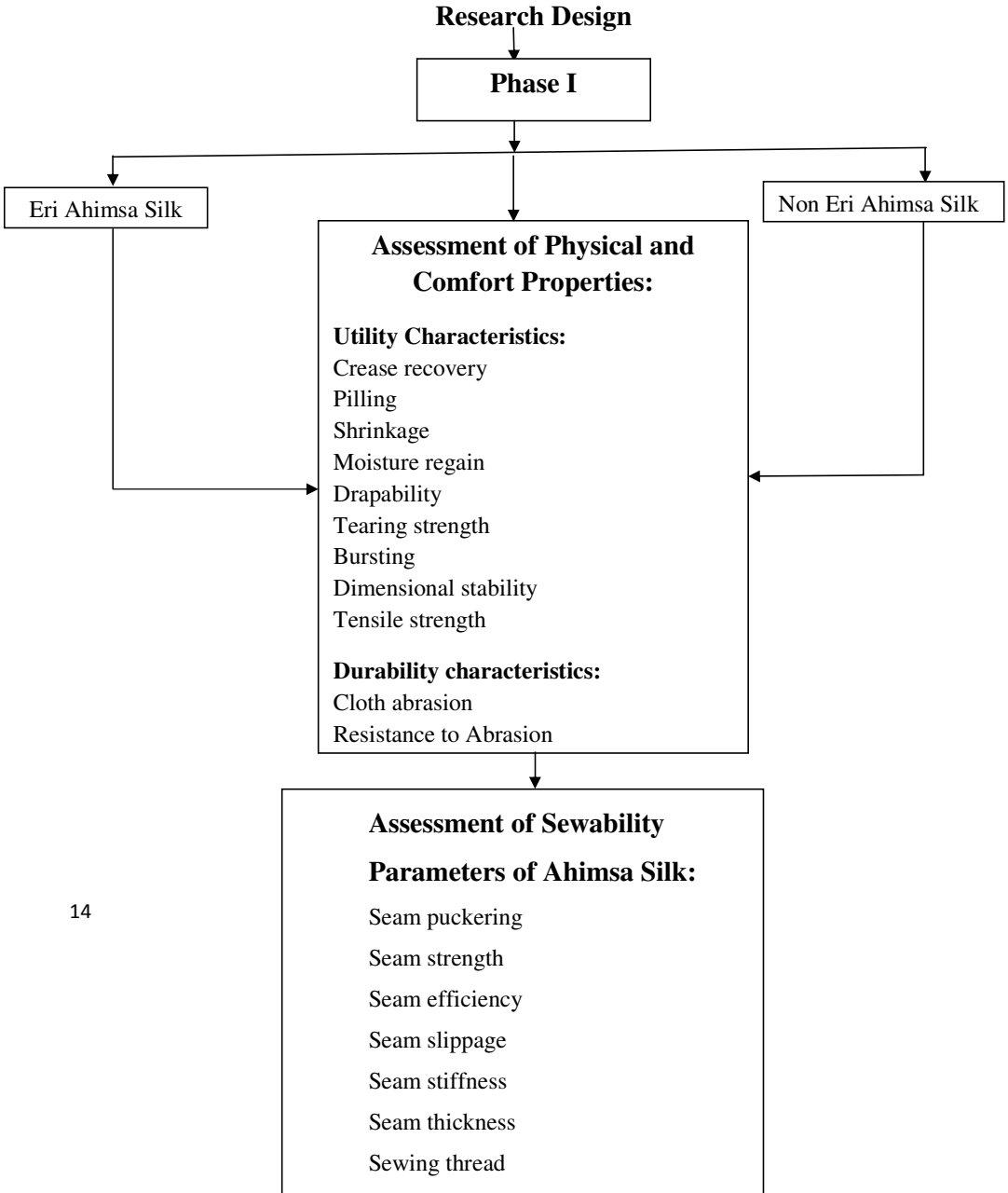
The study will be a milestone in identifying prospective consumers and establishing a market of the eco-friendly ahimsa silk women wear. The study will assist the marketers to make out the budding interest of their women customers and to recognize emerging trends in women fashion.

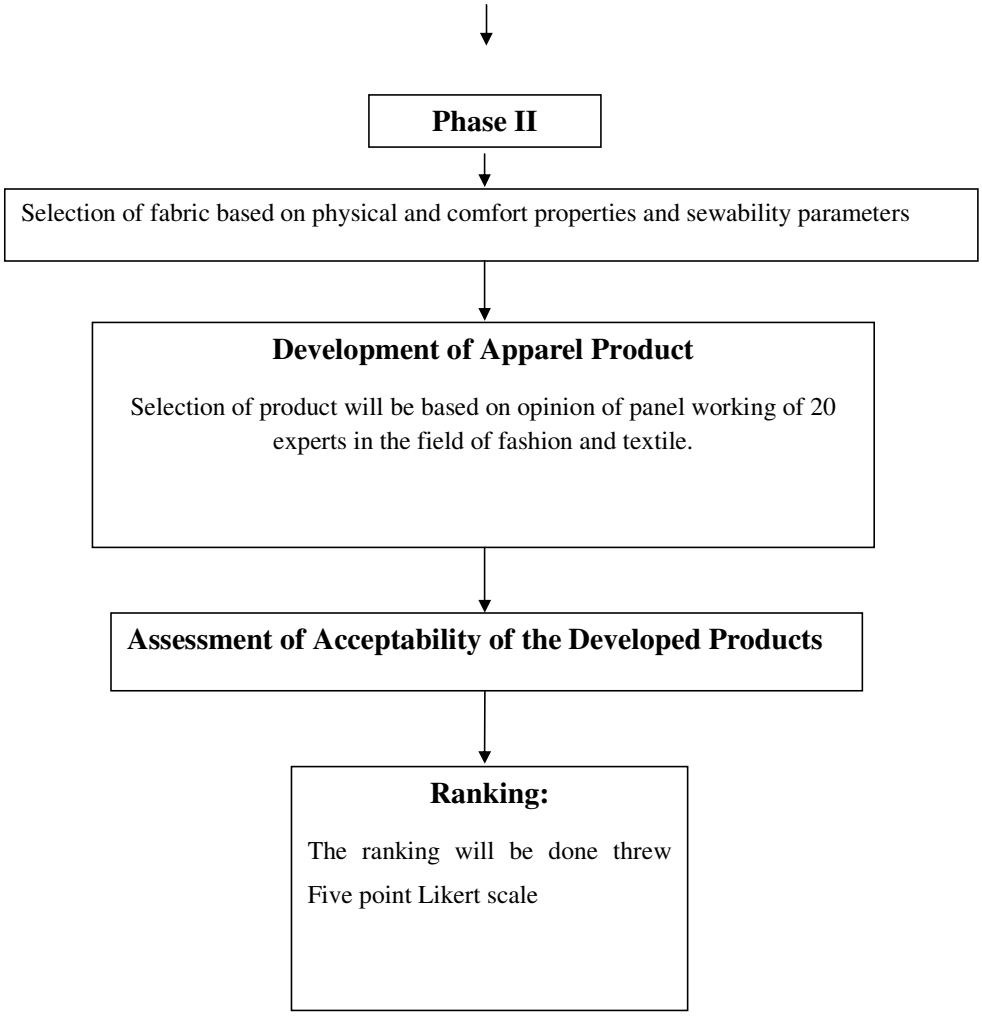
Through research the textile manufacture can develop a suitable fabric and also scientifically inform the consumer about the advantages in using the same over the other available varieties in the market. The study will be helpful in solving the problem faced by consumers in selecting the right type of product.

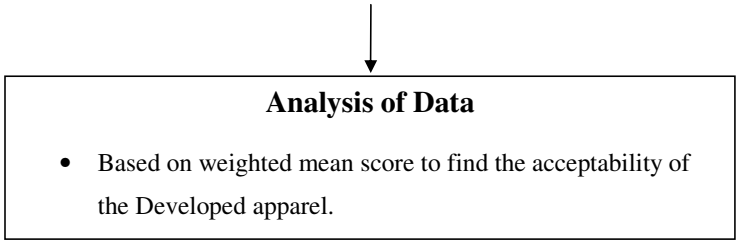
The study will definitely contribute to the knowledge of the physical and comfort properties and the overall seam quality of apparel products that will be helpful to the apparel engineers to evaluate the quality of apparel products more precisely and design ahimsa silk garments with various constructional details.

## Scope of the study

- The work will serve as a guideline of assessment of physical properties of Ahimsa silk and non Ahimsa silk.
- The assessment of sew ability parameters of Ahimsa silk fabric and non Ahimsa silk serve as a guide to develop constructional designs according to their performance.
- The study will help ethical consumers in replacing their regular garment choices with their sustainable and cruelty -free counterparts.
- The study will be a milestone in developing a range of fashion garments for men and women both.
- It will be helpful in developing furnishing items with suitable Ahimsa silk fabric as well.




Phase II
Selection of fabric based on physical and comfort properties and sewability parameters
Development of Apparel Product
Selection of product will be based on opinion of panel working of 20 experts in the field of fashion and textile.
Assessment of Acceptability of the Developed Products
Ranking:
The ranking will be done threw Five point Likert scale




## Methodology

A methodology is a systematic or orderly way of approach towards analysis, information system and information technology that includes the methods, procedures and techniques used to collect and analysis information. It is a strategy and approach to achieve some goal presented as a frame work in which related processes made up of activities or steps are grouped. A methodology is normally used as a guideline rather than as a strict set of instructions.

This section here deals with the methodological details of the present study. The study will be undertaken to assess and compare the physical and comfort properties of Ahimsa silk and non Ahimsa silk fabric and test the sew ability parameters and there by development of women wear by Ahimsa silk fabric according to fabric sew ability.

The research work will be carried out in the following phases:

### Phase - I

- Assessment of physical and comfort properties of Ahimsa silk fabric and non Ahimsa silk fabric
- Assessment of sew ability parameters of Ahimsa silk fabrics and non Ahimsa silk fabric

### Phase - II

- Development of apparel products according fabric performance.
- Assessment of acceptability of the developed products

## Phase I:

## Assessment of physical and comfort properties of Ahimsa silk and non Ahimsa silk fabric

To assess the physical and comfort properties one variety of Ahimsa silk fabric and non Ahimsa silk fabric, viz. Eri Ahimsa silk and non Eri Ahimsa silk fabric will be collected, with compatibility in terms of thread count, thickness of fabric and fabric weight. Physical properties such as, crease resistance (resilience), pilling, shrinkage, tearing strength, bursting, moisture regains (absorbency), dimensional stability, tensile strength and drapability will be assessed through physical quality evaluation laboratory NITRA. The quality and performance of fabric will be determined before testing the sew ability parameters. Following properties of Ahimsa silk and non Ahimsa silk fabric will be assessed and compared:-

## Physical Properties of Ahimsa silk and non Ahimsa silk fabric:

## Utility Characteristics:

Utility characteristics are changes in the fit, comfort, and wearing functions of the garment when the fabric engages a mechanical thermal, electrical, or chemical force during the utilization of the garment. The two major types of utility characteristics are transmission and transformation. A transmission characteristic transmits mass or energy through the fabric. Transmission characteristics include:

- Crease recovery
- Pilling
- Shrinkage
- Moisture regain
- Drapability
- Tearing strength
- Bursting
- Dimensional stability and
- Tensile strength

**Fabric properties:**

- Measuring scale instrument use assess the properties of fabric dimensions and IS 1954-90 Re 2007 ASTM D 3774 standard method used.
- ICI pilling box (tumble type) instrument use assess the properties of fabric resistance to pilling (ICI pilling box method) and IS 10971-84 Re 2006 ASTM 4970-07 standard method used.
- BTRA drape tester instrument use assess the properties of fabric drape and IS 8357- 77 Re 2008 standard method used.
- Crease recovery tester instrument use assess the properties of fabric crease recovery and IS 4681- 81 Re 08 standard method used.
- Ambient air heated instrument use assess the properties of fabric Moisture regains and ASTM 1997 standard method used.
- Shrinkage scale instrument will be assessing the properties of fabric shrinkage and ISO 6330:2000 standard methods used.
- Elmendorf Tear Tester instrument will be assessing the properties of fabric tearing strength Falling Pendulum (Elmendorf-Type) Method and IS: 6489-93 Re 2008 ASTM D-1424-09 standard method used.
- Materiau Ingenierie I–France instrument will be assessing the properties of fabric bursting strength (Diaphragm Bursting) and IS 1966-75 Re 2006, ASTM D 3787-07 standard method used.
- Measuring scale will be assessing the properties of fabric dimensional stability and IS 1954-90 Re 2007 ASTM 3774 standard method used.
- Tensile strength of the fabric will be tested on an Instron Tensile Tester, model 4411 by the grab test method. The ASTM D 5034 test method will be used to measure the strength of the fabric.

## Durability characteristics:

Durability characteristics are the capacities of fabric to maintain the style and utility characteristics during wear. It is the measure of stress which destroys the fabric or the fabrics ability to repeat a desired style or utility characteristic. The durability characteristics will be measured as under:

- Martindale's instrument will be assessing the properties of fabric Cloth abrasion and IS-12673:1989 standard method used.
- Universal Wear Tester; CSI; USA will be assessing the properties of fabric Resistance to Abrasion (Inflated Diaphragm Method) and IS 12673: 89 Re 2005 standard method used.

After assessment of physical and comfort properties, one varieties of Eri Ahimsa silk and non Eri Ahimsa silk fabric will be tested for their sew ability properties.

## Assessment the sew ability parameters of Ahimsa silk and non Ahimsa silk:

On the bases of assessment of physical properties sew ability parameter will be assessed. The sewing parameters will be varied to study its effects on seam strength, seam stiffness, seam puckering, seam thickness, seam slippage, seam boldness, and cover factor, seam damage, seam appearance, seam efficiency, seam performance, needle damage and sewing distortion.

**Sew ability parameters of fabric:**

- Evaluation of the seam pucker will be proposed by the American Association of Textile Chemists and Colorists AATCC test method 8831- 1992 will be used.
- Seam strength will be tested using the Instron tensile tester according to BS: EN – ISO: 13935- 1 1999.
- The test to measure the seam efficiency will be tested according to ASTM 1638- 81.
- Seam slippage test will be performed with reference to ASTM D 434- 95: standard test method for resistance to slippage.
- Seam stiffness test obtained using Shirley stiffness tester according to ASTM D 1388 standard method.
- Seam thickness using Erazier pregision instrument, according to B. S. - 2544.
- Testing of sewing thread properties according to ASTM- D 3828 standard method.
- Seam damage refers to needle cutting or yarn severance in the fabric during sewing (Sandow, 1990 and Tait 1997). Seam damage is measured by the needle cutting index.
- Seam boldness is used to measure the design prominence over seam. Generally, high degree of boldness is required for better ornamentations of apparel. The assessment of seam boldness is mainly by subjective visual means.
- Seam elongation test according to the ASTM 1683-04 standard.
- To determine the cover factor, ends/inch and picks/inch of the fabric were counted by pick glass. ASTM-D 1059-01 standard will be used.

After assessment of sew ability parameters of the one varieties of Ahimsa silk and non Ahimsa silk fabric, the fabric with best sew ability parameters will be selected for product development.

## Phase - II

## Development of apparel products according fabric performance:

The fabric will be selected out of two tested materials according to their performance regarding physical properties and sew ability parameters. The product to be developed with this fabric will be selected according to the opinion of a panel of 20 apparel designers/textile designer and subject experts with an exposure of the material along with the result obtained from their assessed properties. Fabric material will be shown to the experts and their suggestions will be considered as guidelines to develop the product. Garment silhouette will be selected to the selection of product by panel of experts.

A number of designs will be created as per experts' suggestions, out of which few best designs will be selected for the purpose of product development. After selection of the designs through panel of judges, appraisal of the acceptability of the product design will be accomplished.

## Assessment of acceptability of the developed products

**Ranking:** A rating scale is to be used for evaluation will be developed product.

The rating scale will be 5 point Likert scale:

Excellent (5)

Very Good (4)

Good (3)

Average (2)

Poor (1)

Analysis of the responses will be done on the bases of weighted mean score to find out the acceptability of product.

## Limitations of the study

- Only one variety of Ahimsa silk fabric and non Ahimsa silk fabric will be taken for the purpose of study.
- Assessment of only few physical and comfort properties of Ahimsa silk and non Ahimsa silk fabric will be done.
- Assessment of sew ability parameters of Ahimsa silk fabric and non Ahimsa silk fabric.
- Only one type of product will be constructed as per expert opinion.
- The assessment of acceptability of the developed products is limited of Jaipur city.

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